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(54) FLEXIBLE REMOTE CONTROL MECHANISMS

(71) We BOWDEN CONTROLS LIMITED, a British Company of Llanelli, Dyfed, South Wales, SA14 9TF, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flexible remote control mechanisms comprising a conduit within which an inner member or core is longitudinally displaceable for transmitting forces applied thereto.

When such mechanisms are installed for use, the conduit is connected to parts to which the reaction force on the conduit is transmitted. In some installations the conduit is held at or near its ends by fixed conduit clamps. But in many mechanisms there are fixing nuts which can be screwed relative to the conduit for varying the positions at which it is held and thereby adjusting its effective length and the operation of the mechanism.

In some mechanisms having such a screw adjustment facility, the conduit is formed by a closely helically coiled wire which gives the exterior of the conduit the profile of a male screw and the adjustment nuts are in direct screw engagement with the conduit. Other known mechanisms having a said screw adjustment facility have metal screw-threaded end fittings for receiving the nuts, such end fittings being secured to ends of the flexible conduit e.g. by swaging.

Many heavy duty mechanisms having a conduit of relatively sophisticated construction for higher performance specifications have such end fittings but mechanisms have become available in comparatively recent times wherein adjustment nuts are in direct screw engagement with a conduit formed by closely helically interwound wires of different cross-sections so that one of them forms the root and the other of them forms the thread of a male screw (cf United Kingdom Patent No. 1 409 526).

According to the present invention there is provided a mechanism of the kind referred to wherein the conduit comprises a tube on which a wire is helically wound with spaced convolutions along at least one end portion of the tube so that such wire and the tube onto which it is wound together form the profile of a male screw, and wherein adjustment means via which axial reaction forces on the conduit can be transmitted to another part is provided, such adjustment means comprising at least one female threaded member which makes screw-engagement with such male screw and can be screwed therealong to different adjusted positions.

In comparison with known mechanisms in which the conduit has a binder wire wound with spaced convolutions and has attached threaded end fittings, mechanisms according to the invention are simpler and less expensive. The said threaded end fittings account for an appreciable proportion of the production costs.

A mechanism according to the invention can be installed in such a way that an end portion of the conduit projects from a fixture engaged by the female adjustment means and can flex about its anchorage point responsive to axial movements of the inner member by a pivoted actuating or actuated component.

In a mechanism according to the invention there may be a said helically wound wire which extends over the entire length of the conduit, and provides the thread of a said male screw along each end portion of the conduit. If the wire is wound with spaced convolutions along the entire length of the tube the adjustment range of female adjusters screwed onto the conduit can be virtually unlimited. However it is not essential for the wire convolutions to be spaced along

the entire length of the conduit. The wire can be wound with spaced convolutions over one end portion of the tube and with juxtaposed convolutions along the remainder of the tube length, thereby providing an adjuster screw at one end only of the mechanism. Alternatively the wire can be wound with spaced convolutions along opposed end portions of the tube and with juxtaposed convolutions along the intervening part of the tube length, thereby providing adjuster screws at both ends of the mechanism.

Instead of winding a wire along the entire length of the tube, it can be wound along one end portion of the tube to form with the tube a male screw which is confined to that end portion of the conduit; or there may be two helically wound wires wound onto opposed end portions of the tube so as to form adjustment screws at opposite ends of the mechanism.

Hereafter reference will be made to "the thread-forming wire", as if there were only one such wire, but this is only to avoid repeated references to the alternative and thus simplify the description.

The female adjustment means may comprise at one or each end of the conduit, a single nut or a pair of nuts. A single nut can abut against a fixture to transmit axial reaction forces on the conduit. When there is a pair of juxtaposed nuts one can be used as a lock nut for the other while that one abuts against a fixture or the nuts can be screwed against opposed sides of a fixture to clamp the conduit against axial movement in either direction relative to that fixture.

In particularly important embodiments of the invention the female adjustment means comprises at least one nut having a split shank or spigot portion which can be contracted to grip the conduit. The combination of that kind of female adjuster with a conduit having its receptive male screw formed in accordance with the invention as hereinbefore defined is of considerable advantage. Once the adjuster has been clamped onto the conduit the convolutions of the thread-forming wire engaged by the adjuster are relieved or are to a significant extent relieved of axial load under the reaction forces. The depth and form of the thread provided by the helically wound wire can therefore be chosen without the same dependence on the axial loading conditions to be encountered. Moreover a substantial clearance between the female adjuster and the male screw can be tolerated. Such substantial clearance is valuable because it makes adjustments easier and because it extends the degree to which the part of the conduit engaged by the adjuster can be flexed without preventing rotation of the adjuster for adjustment purposes.

The female adjustment means may comprise at least one said nut which has a split shank or spigot portion and which engages the male screw with a thread clearance exceeding tolerances recognised in standard nut and bolt combinations.

The female adjustment nut preferably has an externally tapered split shank or spigot portion axially into a circular aperture in a mount panel or other fixture.

The convolutions of the thread-forming wire can be positively secured to the tube, e.g. by bonding, using an adhesive, or using a fushion technique if the material of the wire or tube or of at least one of the contacting surfaces thereof make this feasible. However positive connection between the wire convolutions and the tube is not essential. Axial thrust exerted on convolutions of the thread-forming wire via the female member in screw engagement therewith tends to tighten the wire onto the tube. In this sense the wire is self-locking. On the other hand there may be need for or advantage in positive anchorage of the wire extremities to the tube. This anchorage can be achieved e.g. by bonding or by means of clamping rings applied around the opposed end portions of the wire and incidentally serving as stops limiting the travel of the female adjustment member or members.

An optional but potentially advantageous feature resides in a plastics sheath or coating applied over the male screw. Such a plastics coating can e.g. be formed by extruding a suitable plastics directly onto the screw. The thickness of the plastics coating must of course be sufficiently small to preserve a screw profile. The plastics coating can assist in holding wire convolutions against axial displacement relative to the tube, should that be necessary so that the wrap tightness of the wire is not so important. The presence of such a plastics coating also has other advantages, e.g. in promoting or preserving smooth movement of the female adjustment member or members and/or in protecting the thread-forming wire and/or the tube from corrosion if that is a hazard. The choice of plastics for the coating can be made on the basis of its wear-resisting, lubricating and other properties and having regard to the material of the tube to which the plastics is to be applied. A suitable plastics for many purposes is polypropylene. Another example of a plastics which can be used is nylon. Bonding of the plastics coating to the tube can be promoted if necessary by pre-coating this substrate with a bonding medium or by pre-treating the substrate surface.

The thread-forming wire can be wound to any required pitch. Preferably this pitch is larger than that provided for by normal thread standards and is akin to that of an Acme thread so that rapid adjustment is

facilitated.

The cross-section of the thread-forming wire can be selected to achieve any desired thread profile. The wire section may have a base facet which is flat; it need not bite into the tube. The facets providing the thread flanks can be parallel or they can converge or diverge from the base facet. A wire of round cross-section is also suitable.

In a preferred construction the wire is of elongate cross-section and is wound with one of its wider facets against the tube. Such a wire can have a cross-section of substantial area and yet be relatively easily wound. The use of a thread-forming wire of trapezoidal section to form a thread of dovetail section also deserves special mention as providing for very adequate axial thrust transmission via the female adjustment member or members.

The construction of the tube onto which the thread-forming wire is wound is open to choice.

As an example the tube can consist of or include one or more layers of helically wound metal wires, e.g. the tube can be formed by one or more wires closely helically wound in opposite hand to the surrounding thread-forming wire. For forming a tube capable of resisting high tensile loads, such as may be required if the mechanism is intended for transmitting push loads via the inner member, it is advantageous for the tube to comprise a long-lay stranded metal tube, i.e. a tube formed by a multiplicity of metal strands helically wound with a long pitch. Generally the strands of long-lay stranded metal tubes are wound to a pitch such that as viewed in elevation the strands are at all points inclined at less than 45° and preferably at less than 30° to the axis of the tube. There may be a single layer of such a long-lay construction or two or more such layers in which latter case the strands of different layers may be wound to opposite hands. A long-lay stranded metal tube is not in itself highly resistant to compressive loads unless wrapped by a constraining binder wire. In embodiments of the present invention in which a said long-lay tube is employed the thread-forming wire may also serve as a said binder wire.

The tube may incorporate one or more layers of metal wires and one or more plastics layers, e.g., an inner plastics layer forming an integral plastics lining. Such an integral lining can be exposed to the inner force-transmitting member. However any mechanism according to the invention can incorporate a plastics liner fabricated separately from the conduit and located within the conduit bore.

As a further alterantive tube construction, it can be formed entirely of plastics or of plastics incorporating embedded metallic or non-metallic reinforcement. As an example, the tube can be constituted by one or more lengths of polyester stretch tubing.

The inner force-transmitting member can for example be a flexible wire, a stranded wire cable of simple or composite structure, e.g. a structure comprising a long-lay stranded wire core wrapped by one or more helically wound binder wires, or a metal strip.

The invention is primarily intended for embodiment in pull and/or push mechanisms wherein the inner force-transmitting member makes direct sliding contact with the conduit or a conduit liner. However the invention can be applied to mechanisms comprising an inner force-transmitting member in the form of a metal strip supported by ball or roller bearings in the conduit.

Certain embodiments of the invention, selected by way of example, are illustrated in the accompanying drawings comprising Figs. 1 and 2 which are part-sectional elevations of parts of two different mechanisms according to the invention.

The remote control mechanism shown in Fig. 1 comprises a flexible conduit 1 within which an inner member 2, e.g., in the form of a stranded wire cable, is longitudinally displaceable for transmitting forces applied to one end of that member.

The conduit 1 is of composite construction, comprising a long-lay stranded metal tube 3 and an outer wire 4 which is helically wound with spaced convolutions around that tube. The wire 4 is of flat elongated cross-section with slightly rounded corners, and is wound with one of its wider facets against the long-lay tube. The wire 4 is wound in the same manner along the entire length of the conduit and the extremities of the wire are clamped to the tube 3 by swaged metal rings. One of these rings, designated 5, appears in the drawing.

The wire 4 forms a binder wire for the strands of the long-lay tube and also forms the thread of a male screw, the root of the screw being formed by the portions of the long-lay tube exposed between the convolutions of that wire. A female adjustment nut 6 is in threaded engagement with that male screw. The nut can easily be rotated to different positions along the conduit by finger operation. The nut is made of plastics and has an externally tapered shank or spigot portion 7. A number of axial slots, e.g., three or four such slots, angularly spaced around the axis of the nut, are present in that tapered portion of the nut, one of those slots being apparent in the drawing and being designated 8. The segments of the tapered spigot between the slots are capable of being forced inwardly to grip the conduit and thus hold the nut in an adjusted

position. This clamping action can be achieved simply by pushing the spigot of the nut together with the embraced portion of the conduit into an aperture 9 in a mount panel 10. In the instance illustrated, the aperture is tapered to match the taper of the nut spigot.

In one mechanism of the form shown in the drawing, the thread formed by the wire 4 had a pitch of .250" and a depth of .025".

Within the long-lay tube there is a plastics liner 11. This may be gripped by the wires of the long-lay tube or it may be a loose member axially retained within the conduit by retaining flanges on the conduit, e.g., by flanges on the swaged end rings 5.

It will be apparent from the foregoing specification that numerous modifications of the illustrated embodiment could be made within the scope of the invention. For example a wire of some other cross-section such as a dovetail or Vee section could be employed in place of the flat wire 4; the conduit could comprise, instead of the long-lay tube, a tube formed by a single wire closely helically wound with a shallow pitch and in the direction opposite to the winding of the thread-forming wire, or formed by twin wires closely helically interwound with a shallow pitch and of such cross-sections that flexure of the conduit tends to cause relative transverse displacement of the convolutions of the different wires so that the effective length of the conduit remains substantially unchanged, as known per se in the art. Instead of the nut 6 a pair of nuts of ordinary external form for tightening against opposed sides of a mounting panel or bracket could be used. However as already stated in mechanisms according to the invention there are special advantages in using a nut which can be clamped onto the conduit.

A coating of plastics, e.g. nylon, can advantageously be applied to the outer surface of the conduit, i.e. so as to cover the wire 4 and the portions of the tube 3 exposed between the convolutions of that wire.

Fig. 2 shows part of a mechanism according to the invention wherein a plastics coating is present on the conduit. The mechanism comprises a flexible conduit 12 within which there is a plastics liner tube 13. An inner member 14, e.g. a stranded wire cable, is longitudinally displaceable within the conduit and liner tube for transmitting motion. The conduit comprises a long-lay stranded metal tube 15 and an outer wire 16 which is helically wound with spaced convolutions around that tube. This binder wire is of circular cross-section. The end portions of the binder wire are held in end caps such as 17 at opposite ends of the conduit.

A coating 18 of polypropylene has been applied on the conduit so that it envelopes the long-lay tube 15 and the binder wire 16. Such a coating can be applied e.g. by direct extrusion of polypropylene onto the conduit as it is conveyed through a plastics extrusion head surrounding the path of the conduit. The plastics coating forms at the surface of the conduit a male screw profile which is dependent on but slightly differs from the screw profile at the surface of the uncoated conduit. The flanks of the thread formed at the surface of the plastics coating rise less abruptly from the root face between the neighbouring thread convolutions. Notwithstanding this modification of the male screw profile a very firm anchorage of the conduit is obtainable by means of the female adjustment member 19 which is a plastics nut having an externally tapered spigot portion 20 with slots such as 21 angularly spaced around the axis of the nut so that such portion can be clamped against the conduit by pushing the spigot portion into an aperture having a corresponding taper and formed in a bracket 22 on a suitable fixture.

WHAT WE CLAIM IS:—

1. A flexible remote control mechanism comprising a conduit within which an inner member or core is longitudinally displaceable for transmitting forces applied thereto, in which mechanism the conduit comprises a tube on which a wire is helically wound with spaced convolutions along at least one end portion of the tube so that such wire and the tube onto which it is wound together form at the exterior of the conduit the profile of a male screw, and adjustment means via which axial reaction forces on the conduit can be transmitted to another part is provided, such adjustment means comprising at least one female threaded member which makes screw-engagement with such male screw and can be screwed therealong to different adjusted positions.

2. A mechanism according to claim 1, wherein the said adjustment means comprises at least one female threaded member having a split shank or spigot portion which can be contracted to grip the conduit.

3. A mechanism according to claim 2, wherein said threaded member having a split shank or spigot portion engages the said male screw with a thread clearance exceeding tolerances recognised in standard nut and bolt combinations.

4. A mechanism according to claim 2 or 3, wherein said split shank or spigot portion is externally tapered towards its free end.

5. A mechanism according to any preceding claim, wherein the conduit has a plastics sheath or coating covering the said helically wound wire and portions of the tube intervening between neighbouring convolutions of such wire, so that the said male screw profile at the exterior of the conduit is at the surface of said sheath or coating.

6. A mechanism according to any preceding claim, wherein said tube consists of or includes a long-lay stranded metal tube.

7. A mechanism according to any preceding claim wherein there is a said helically wound wire which extends over the entire or substantially the entire length of the conduit.

8. A mechanism according to any preceding claim, wherein said helically wound wire has a flat facet in contact with said tube.

9. A mechanism according to claim 8, wherein the said wire is of elongate cross-section and one of its wider facets is against said tube.

10. A mechanism according to any of claims 1 to 7, wherein said helically wound wire is of round cross-section.

11. A flexible remote control mechanism substantially as herein described and shown in Fig. 1 or Fig. 2 of the accompanying drawings.

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1579840 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

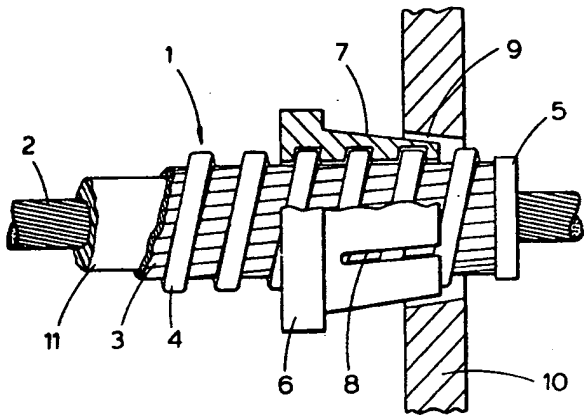

Fig.1

1579840 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

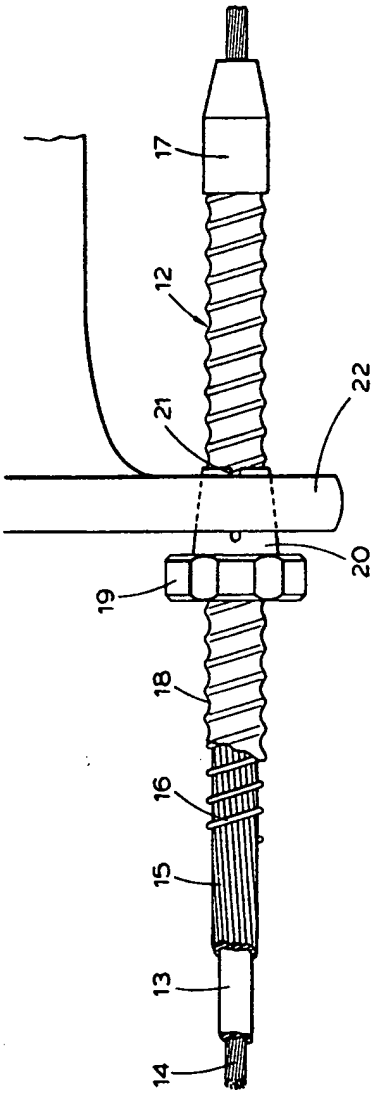

Fig.2